

# PX Application Sensitivity and Rainfall Analysis

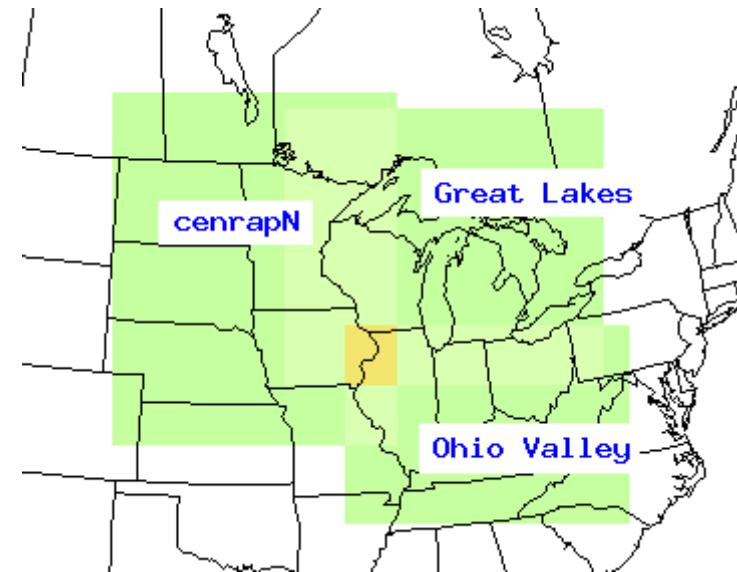
Kirk Baker – LADCO

Ad-Hoc Meteorological Modeling Meeting  
July 30, 2003 (2003242)

Contributions by: Steve King, Illinois EPA;  
Jim Haywood, Michigan DEQ; Wusheng Ji Wisconsin DNR

# MM5 PX LSM Simulations

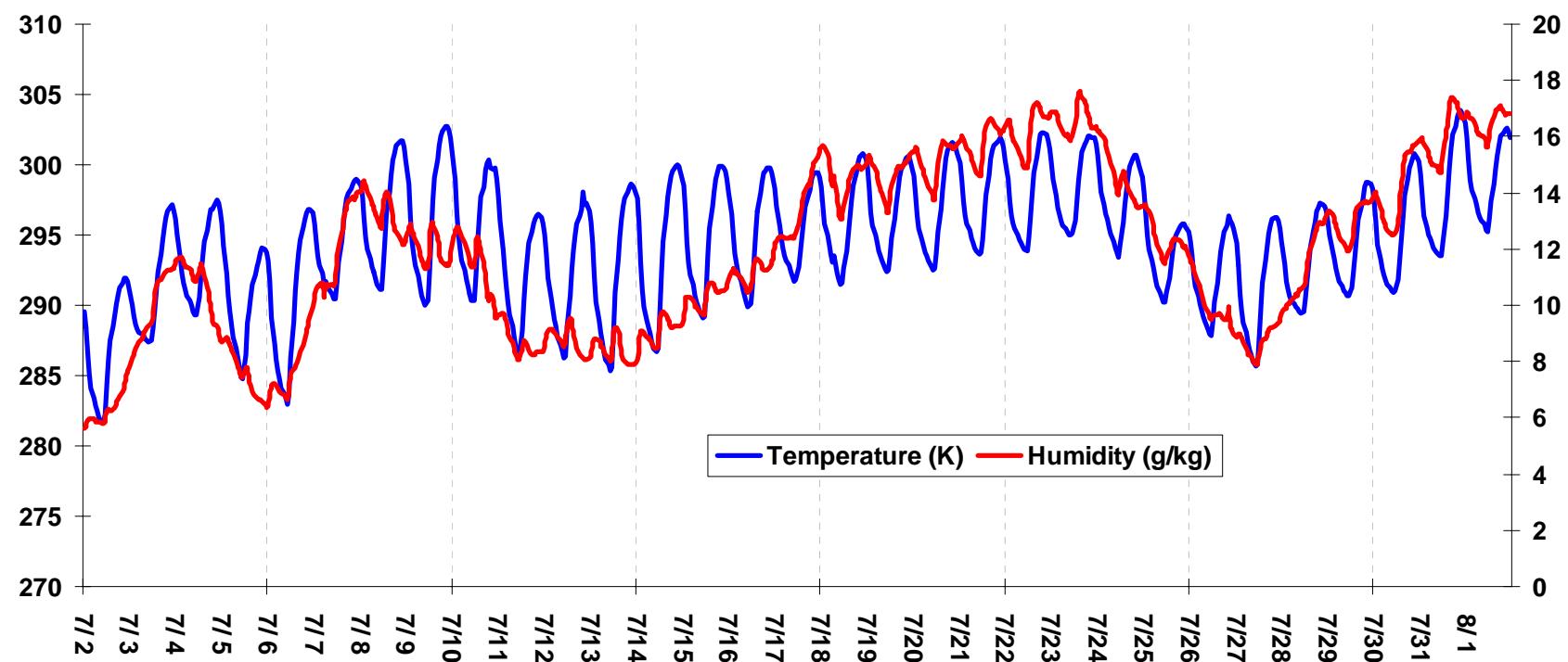
- Using ETA soil data to initialize each 5 day 36km MM5 simulation [ETA INIT]
- Re-initializing soil moisture data from previous 5 day 36km MM5 simulation [INTERPX]
- 36km and 12km 2-way nest simulation (Eta soil)
- Monthly rainfall 36km MM5 estimates compared to monthly rainfall observations over entire Eastern United States



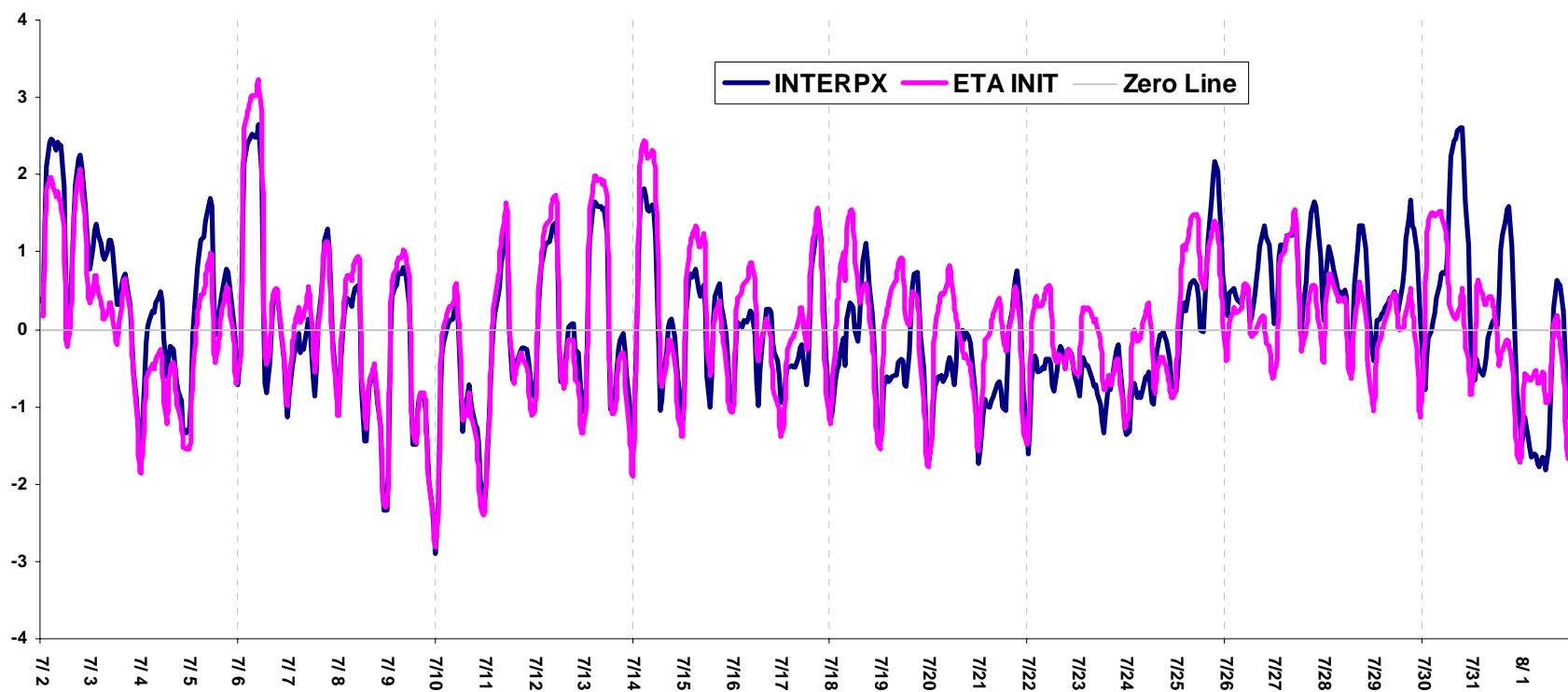
- Statistical evaluation done for the Great Lakes sub-region (36km grid cells)
- Approximately 150 stations

# Average Hourly Observations

## Temperature (K) & Humidity (g/kg)

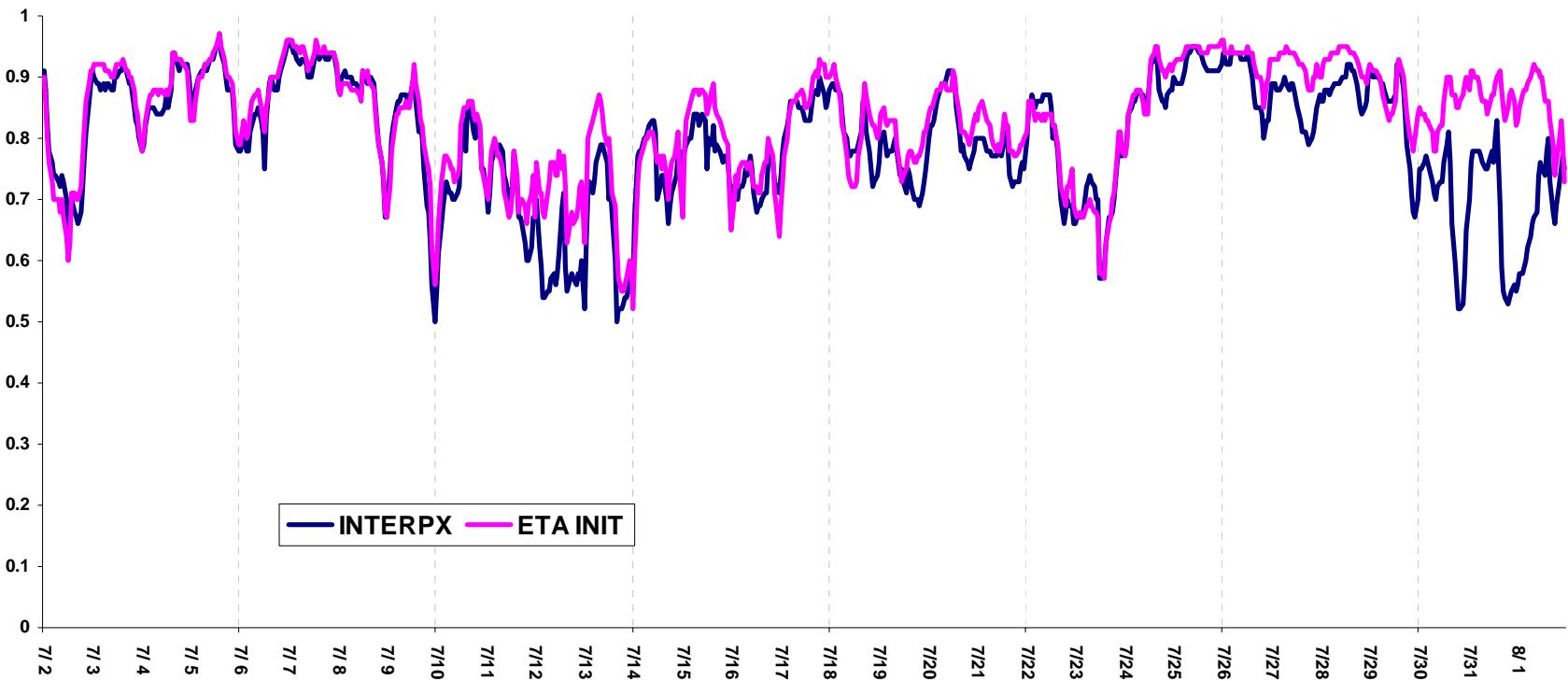


# Temperature Bias

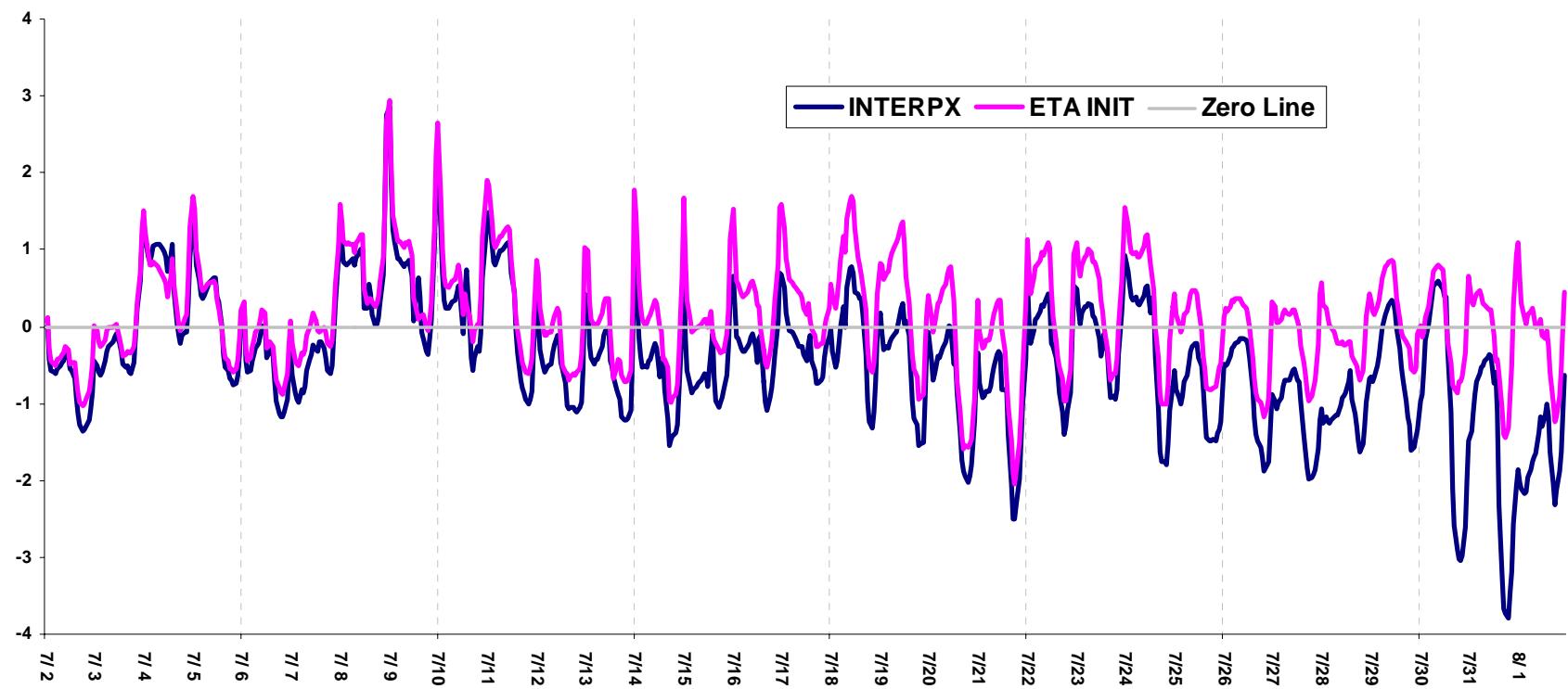


\* Dotted lines indicate the change to a different 5 day episode block

# Humidity Index of Agreement

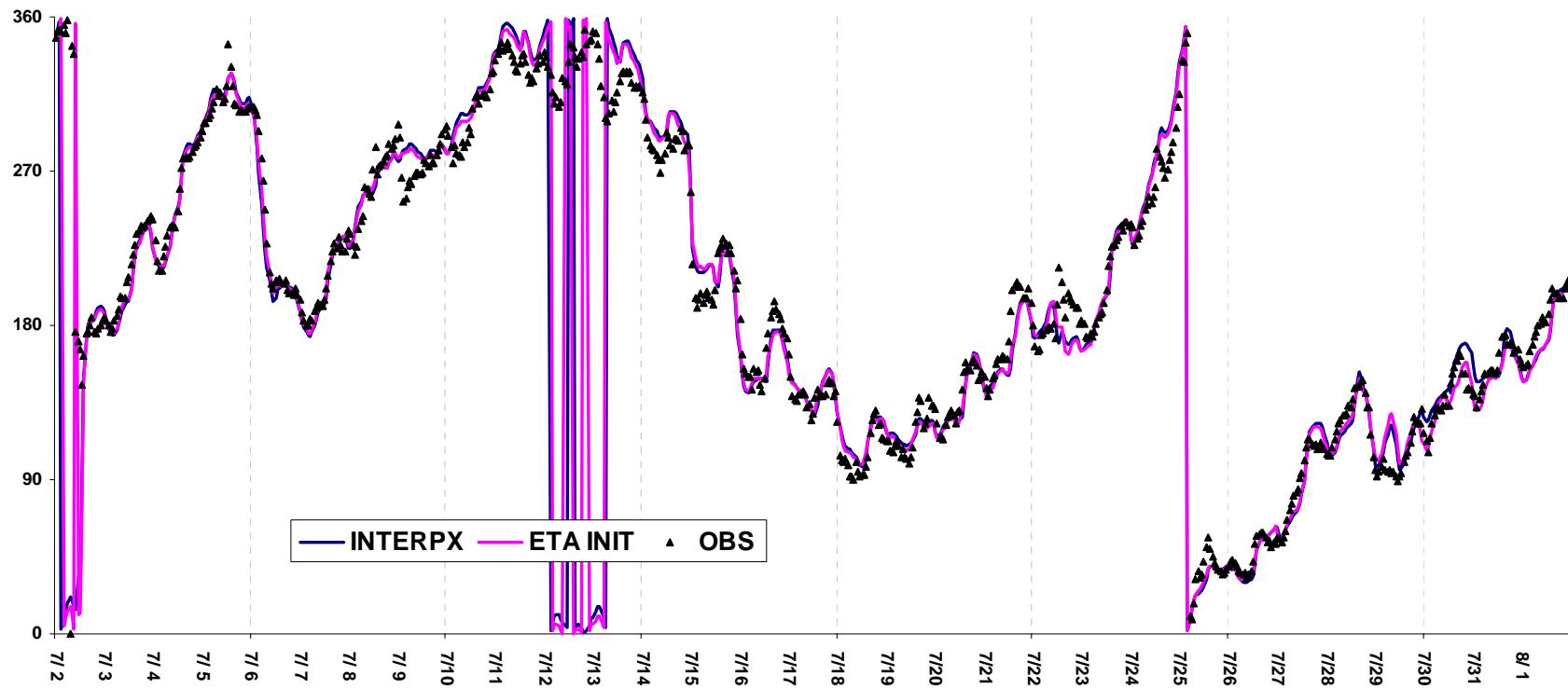


# Humidity Bias

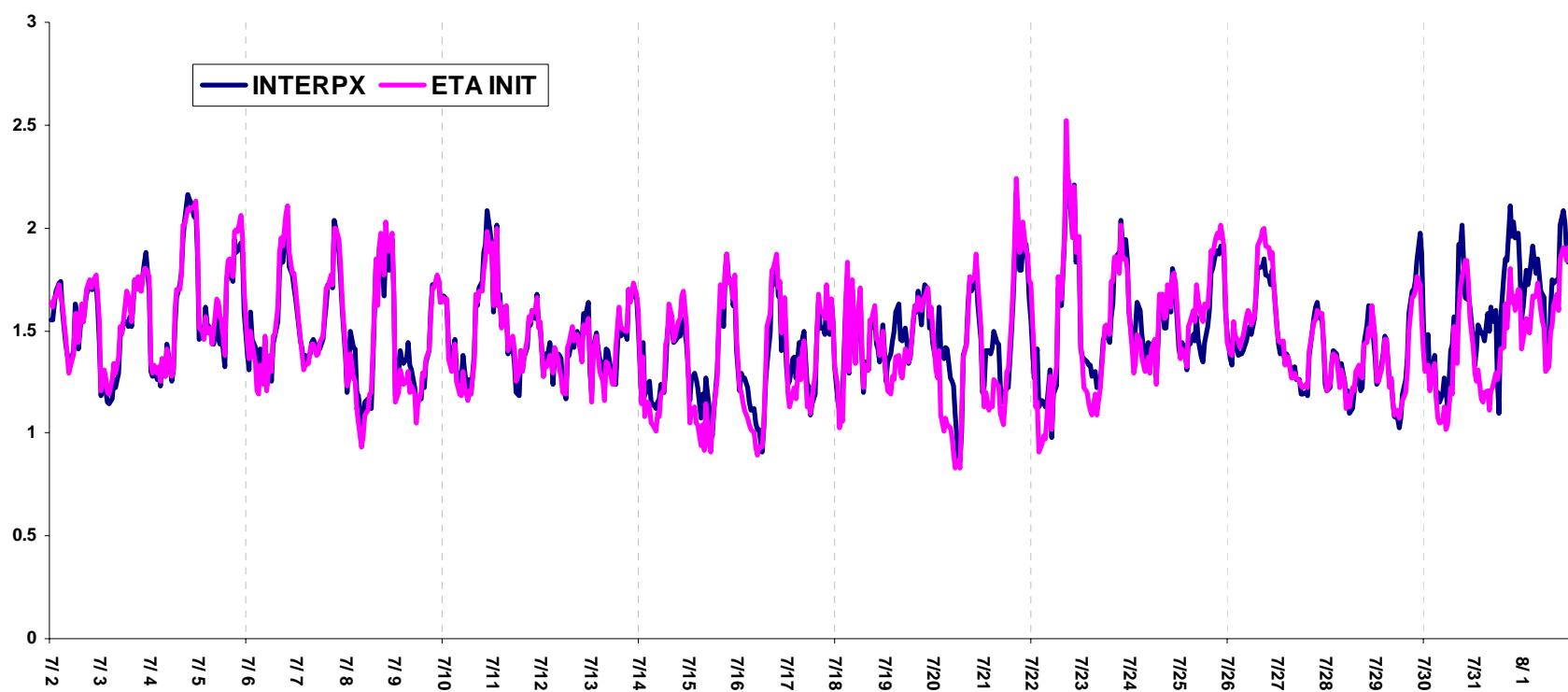


# Wind Direction

Average Predictions & Average Observations (compass degrees)



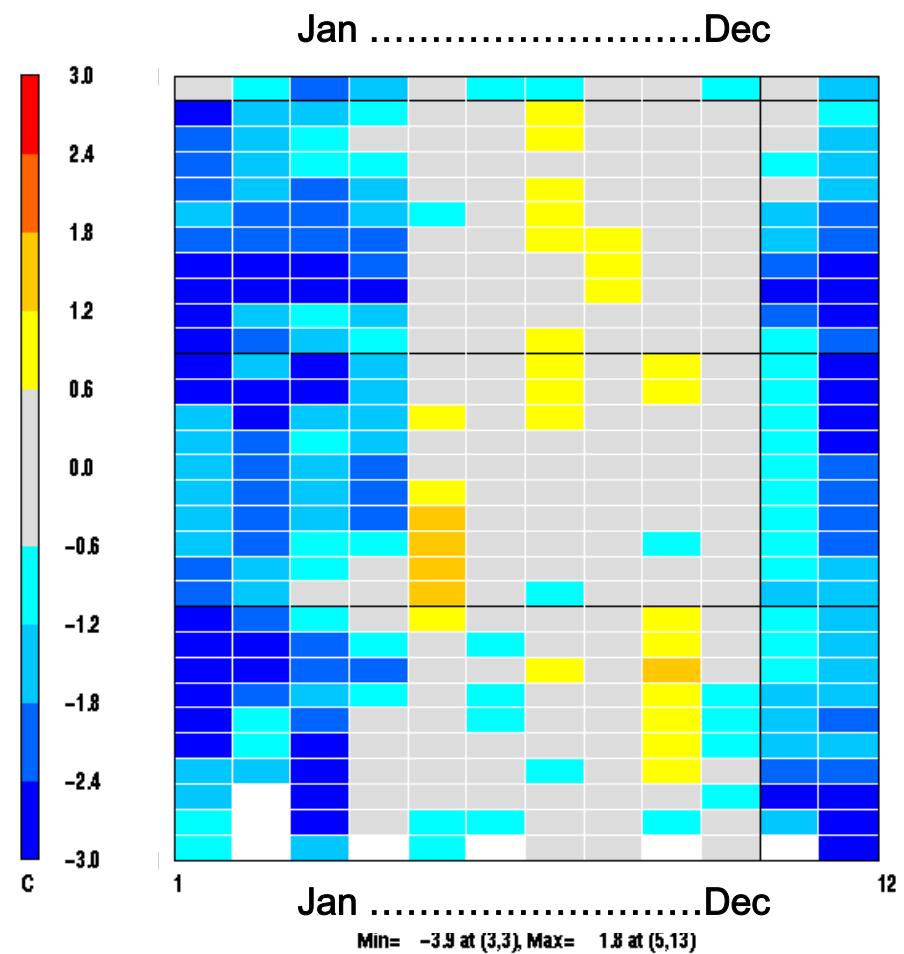
# Wind Speed RMSE



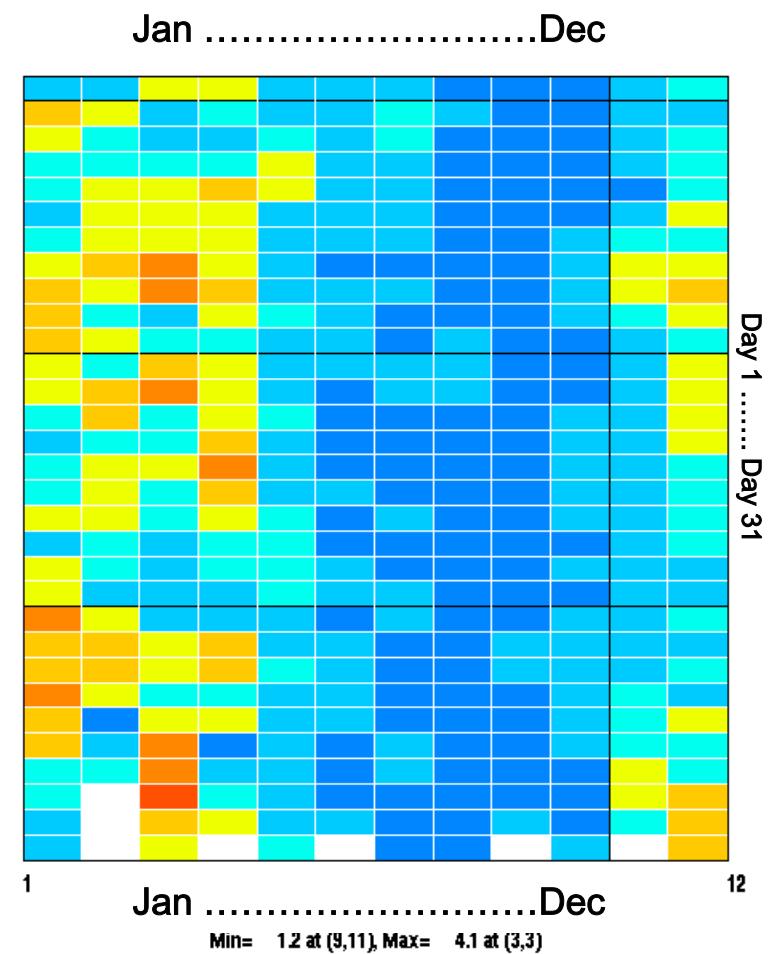
# LADCO Annual 2002 MM5 Run

## Daily Temperature Metrics

BIAS

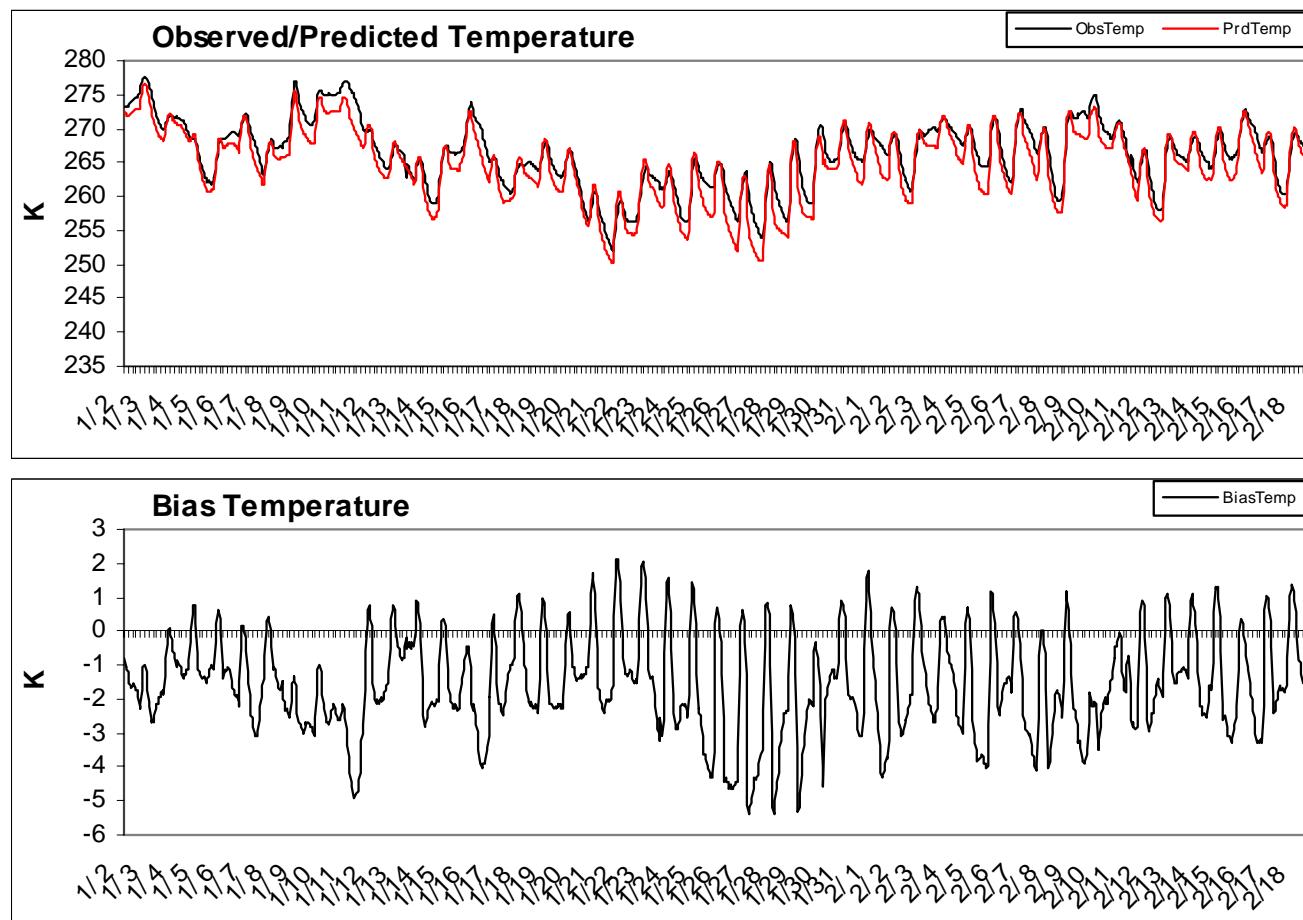


Gross Error

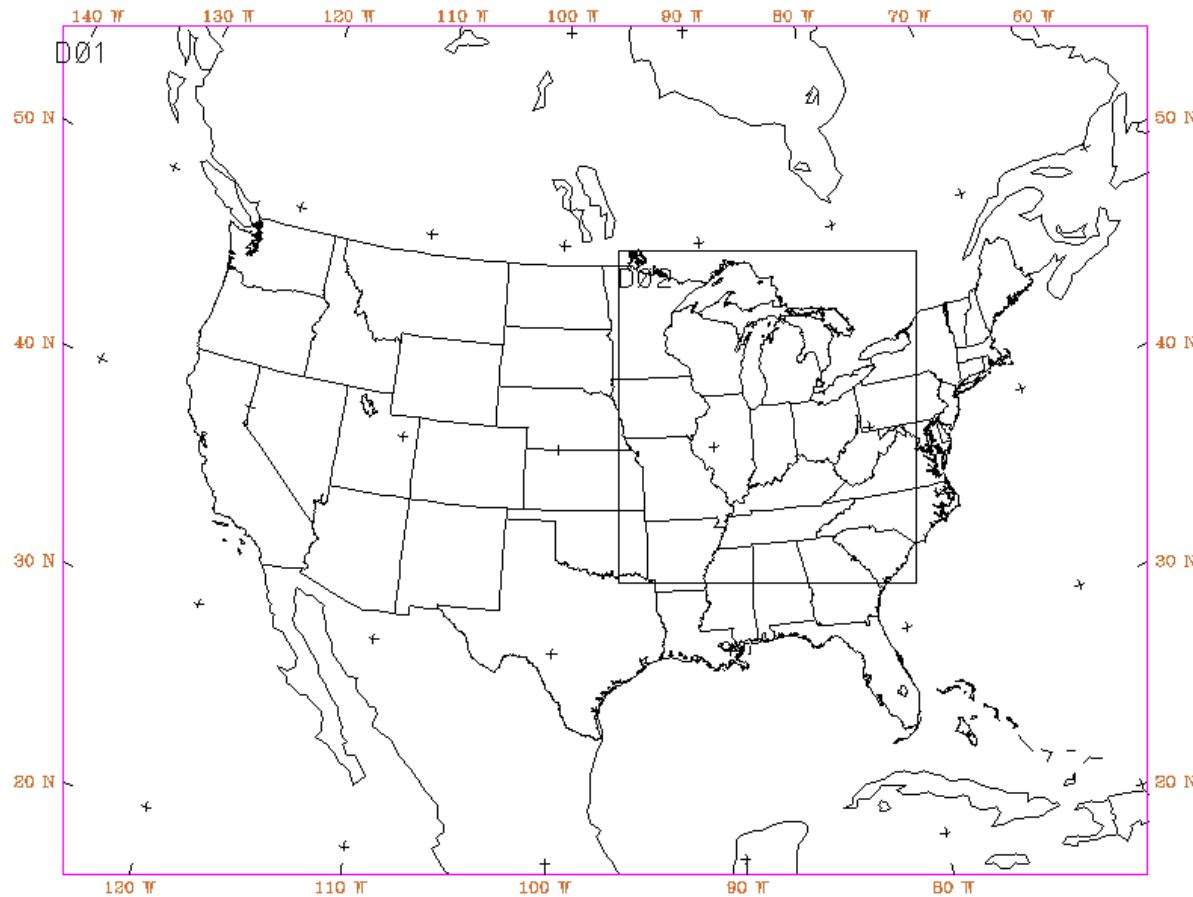


# January 2000 MM5 Simulation

LADCO Natl 36km

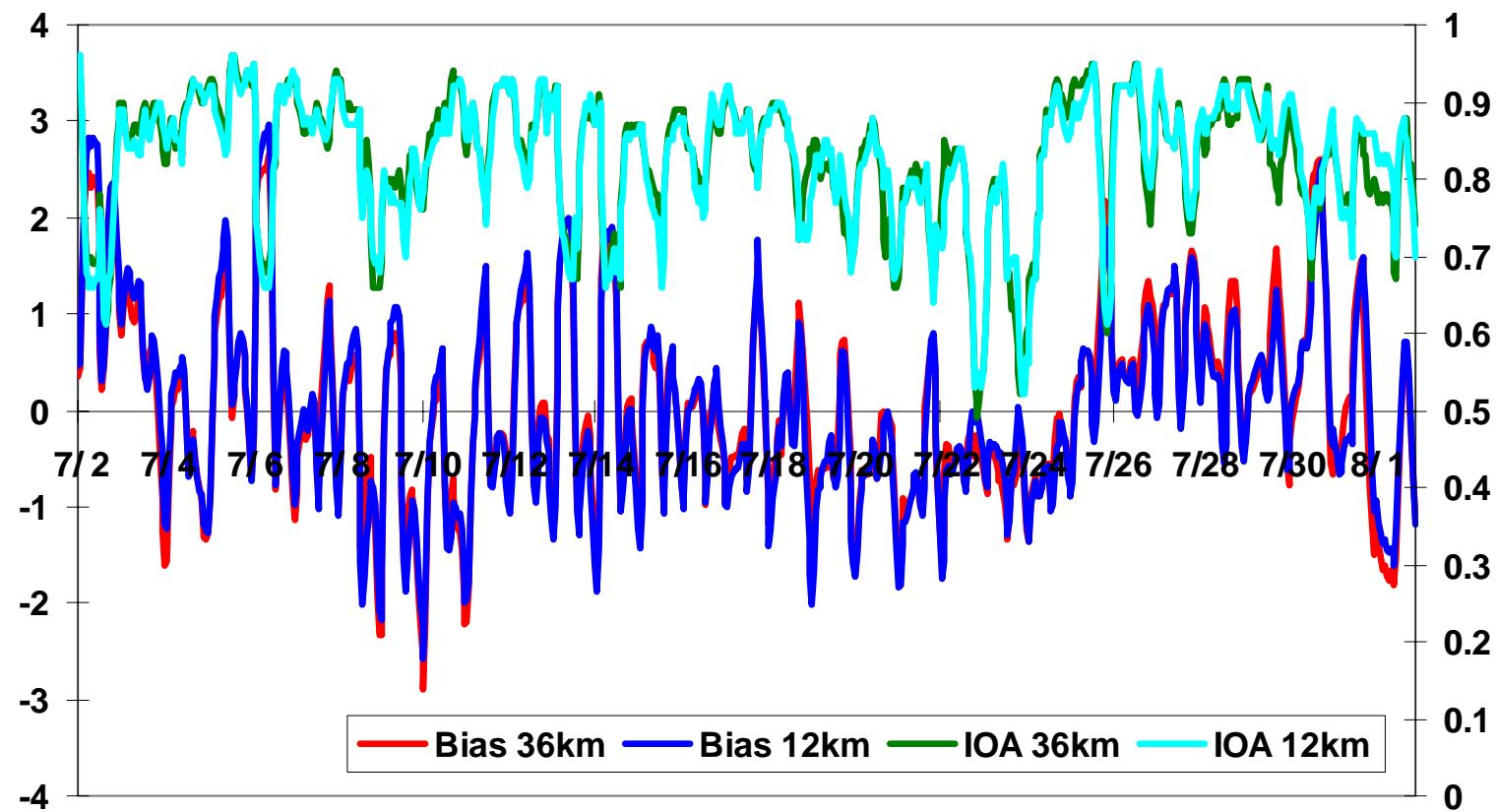


# PX at 36 km with a 12 km 2-way Nested Grid



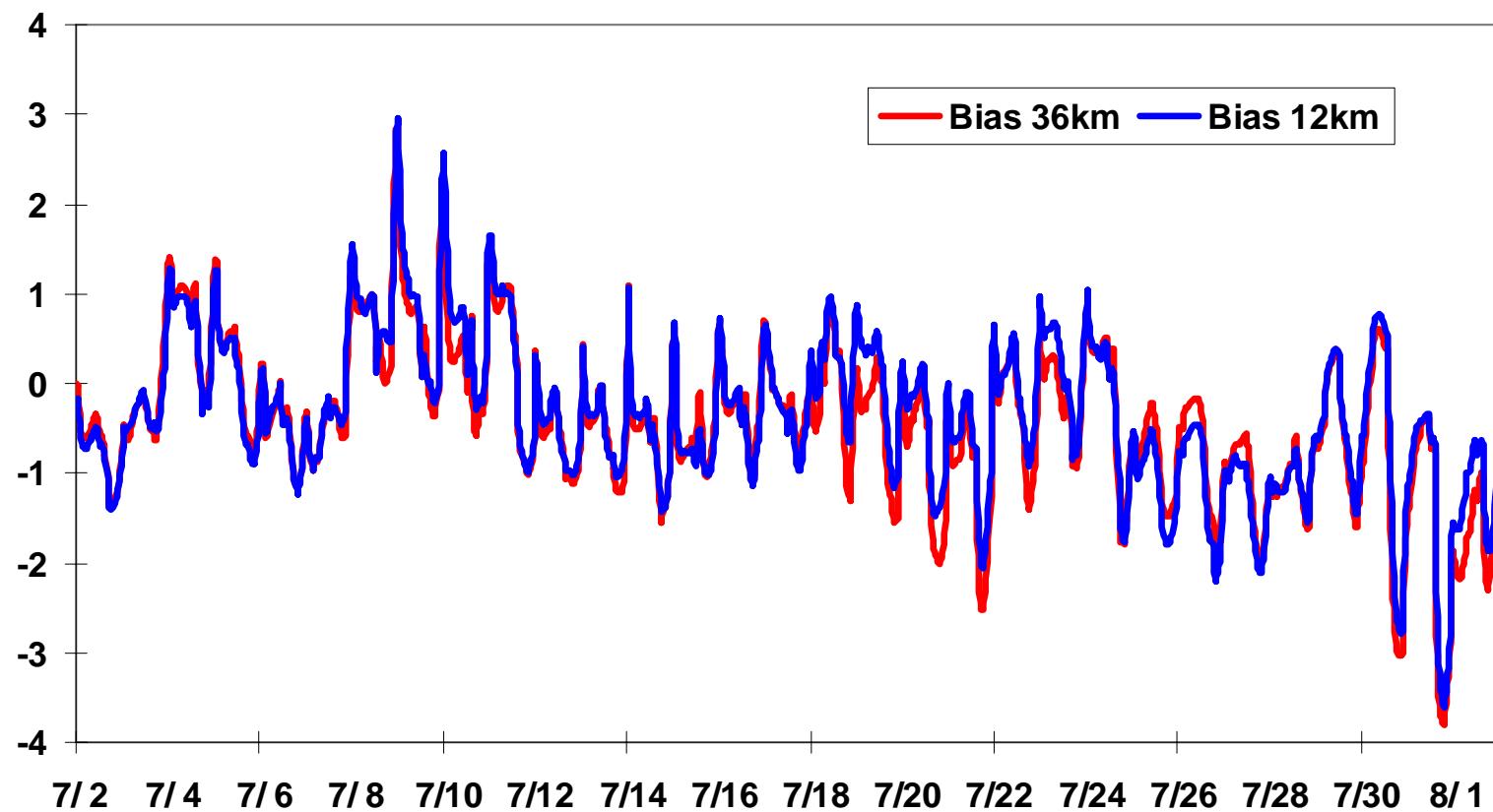
# Temperature (K)

## 36 & 12 km



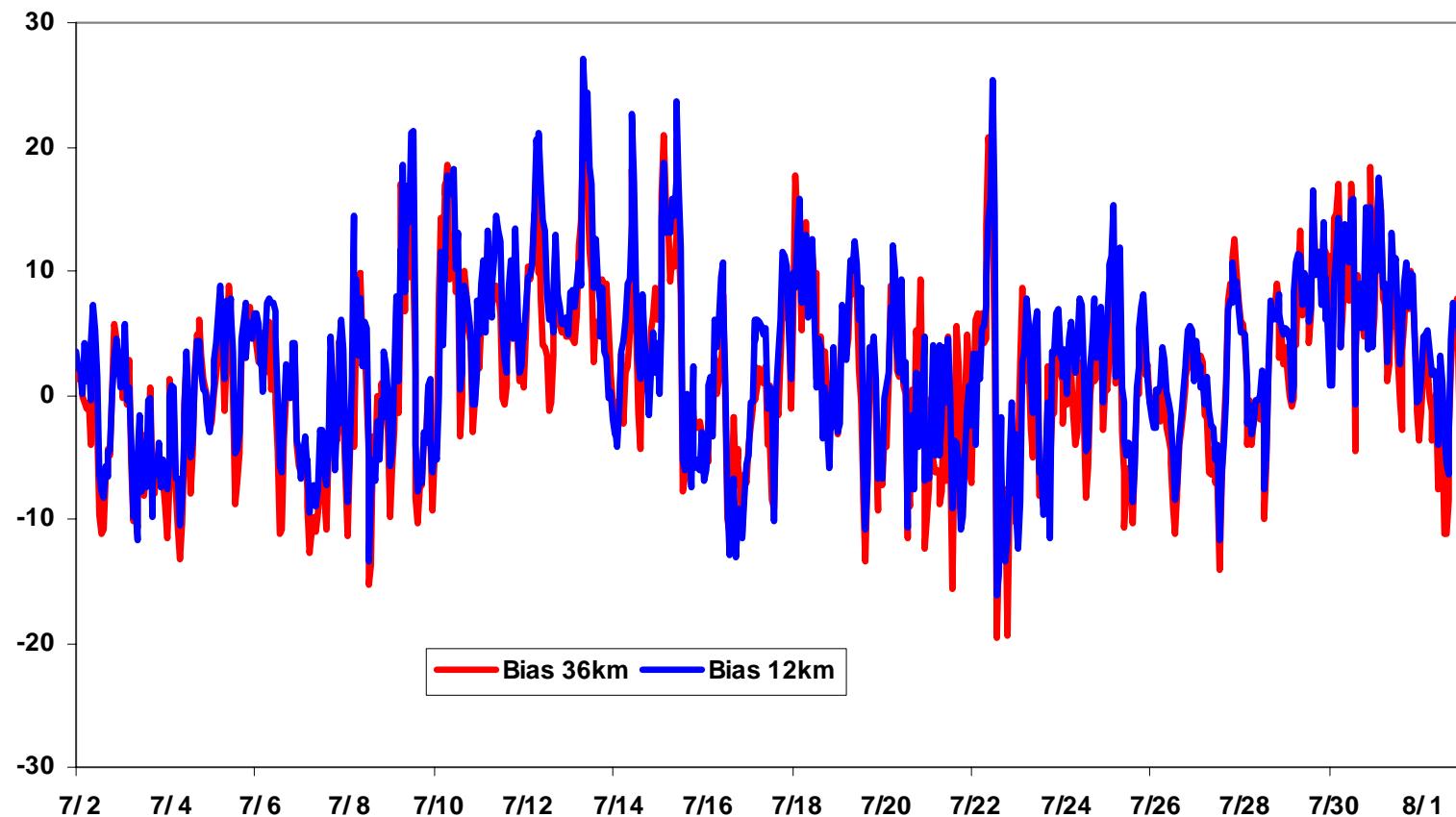
# Humidity (g/kg)

## 36 & 12 km



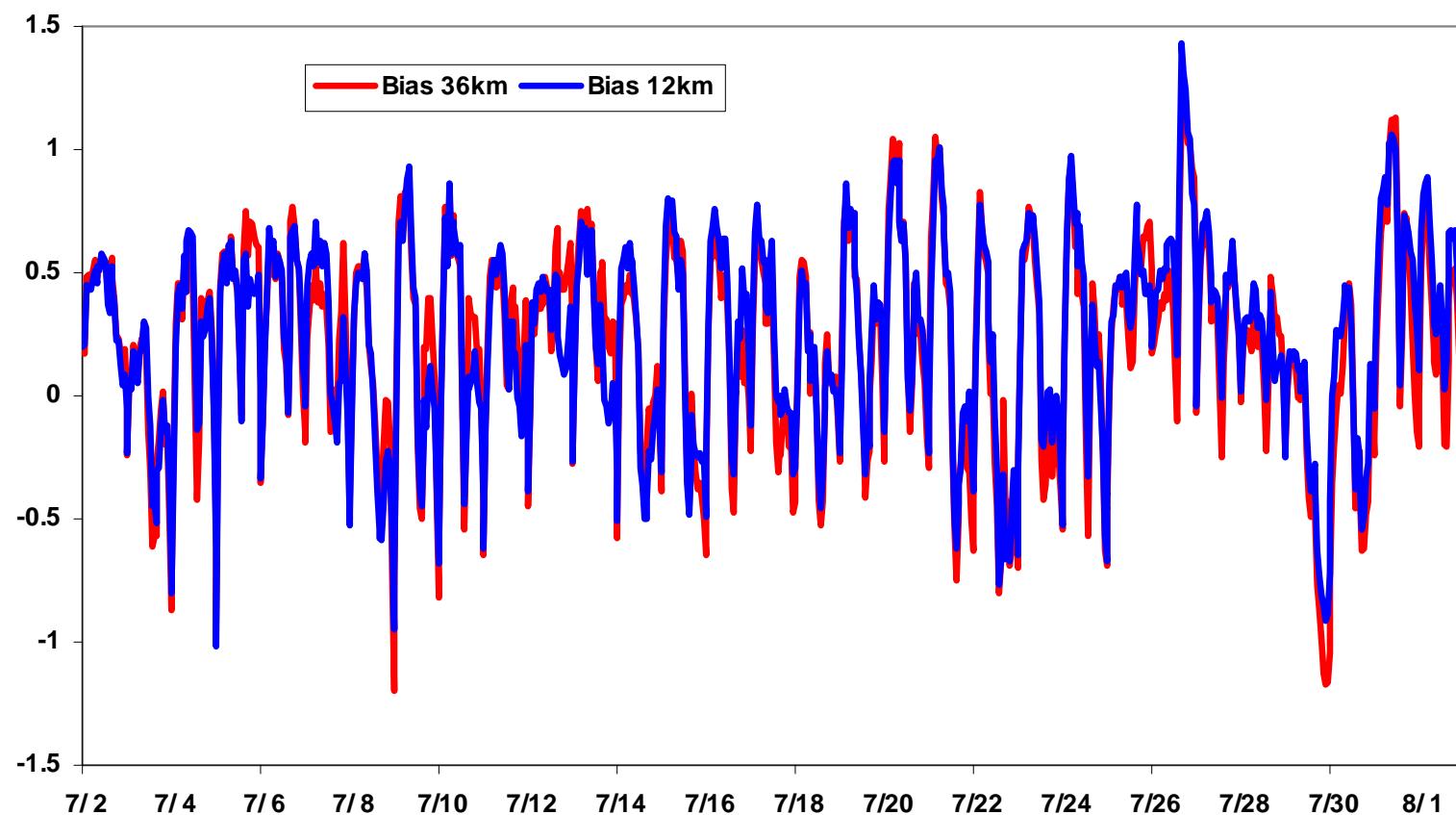
# Wind Direction (degrees)

## 36 & 12 km



# Wind Speed (m/s)

## 36 & 12 km



# Part I Conclusions

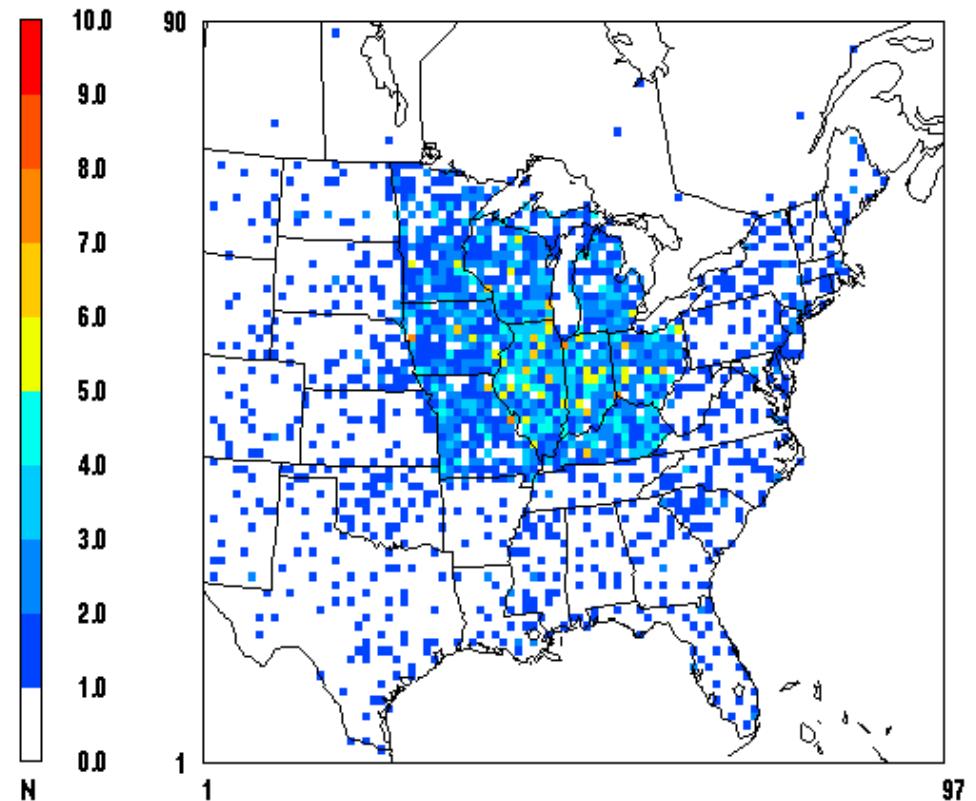
- ETA re-initialization probably a better approach than using INTERPX for current PX implementation in MM5
- No significant improvement in performance in the 12 km grid over the 36 km grid
- Need to examine 4 km performance
- Need to re-run the winter months of the 2002 annual simulation?

# MM5 Rainfall Evaluation

- Explicit Moisture: Simple ice
- PBL: Pleim-Xu
- Multi-Layer Soil Model: Pleim-Xu
- Radiation: RRTM
- Cumulus: Kain-Fritsch
- 4-D Data Assimilation: Analysis nudging on; only above PBL
- Shallow convection: No
- Moist Physics Table: No

# MM5 Rainfall Evaluation

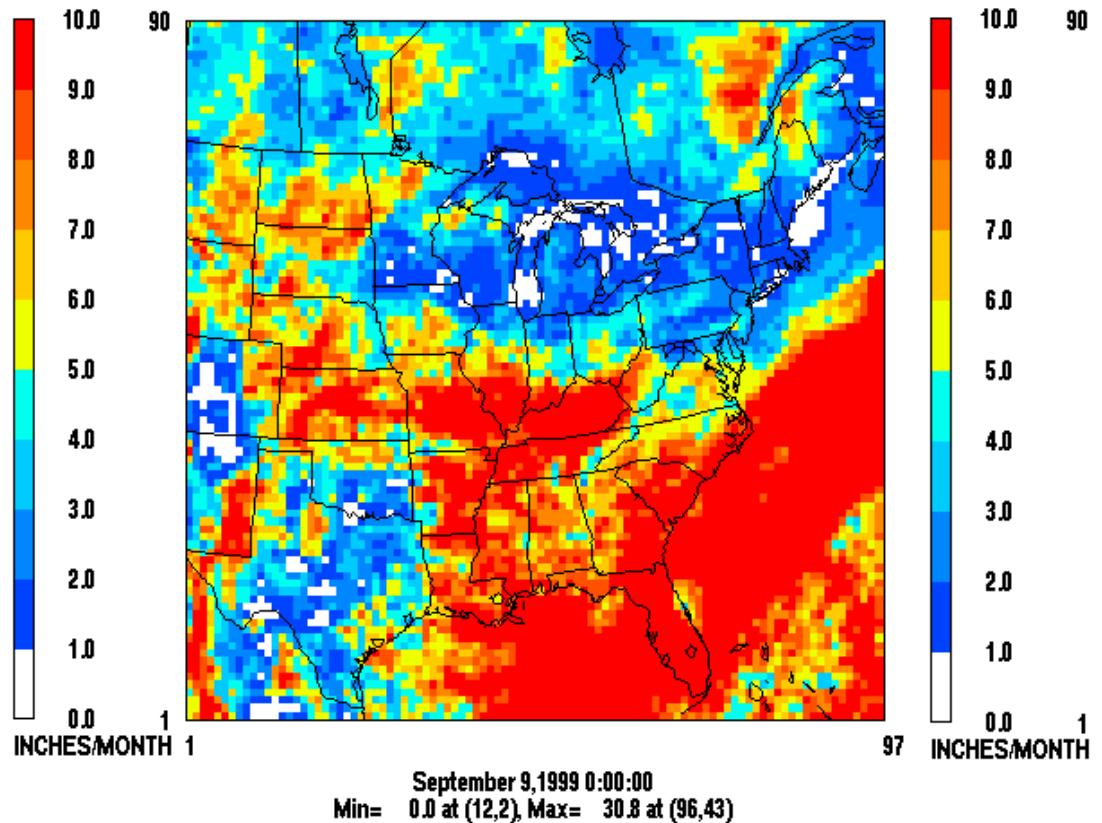
- Midwest Climate Center Data
- National Climate Data Center
- Stations are plotted to the 36km grid
- Plot shows the number of stations in each grid cell



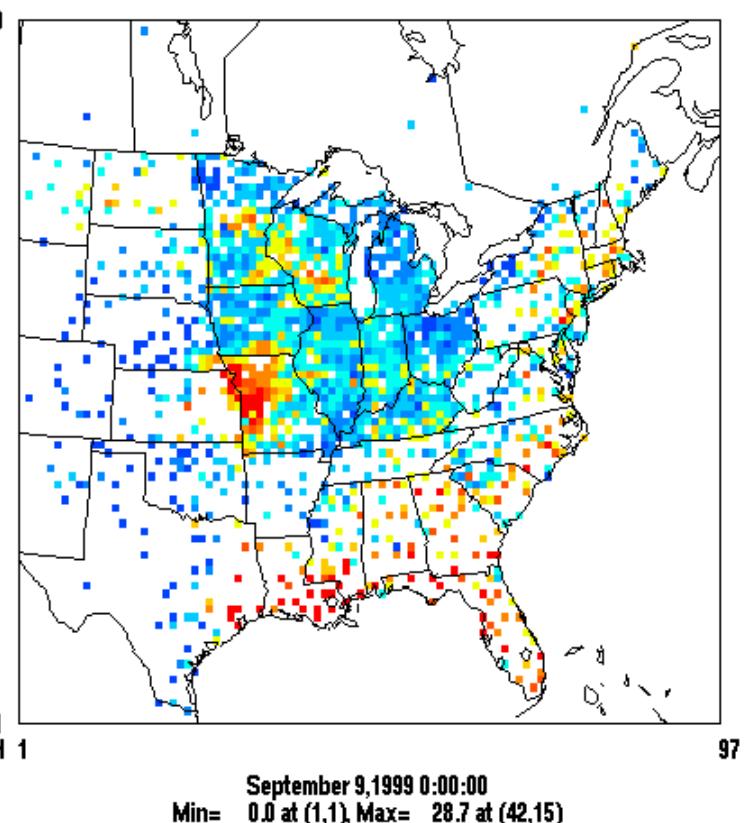
# Monthly Rainfall Totals

## July 2001

MM5 Predictions



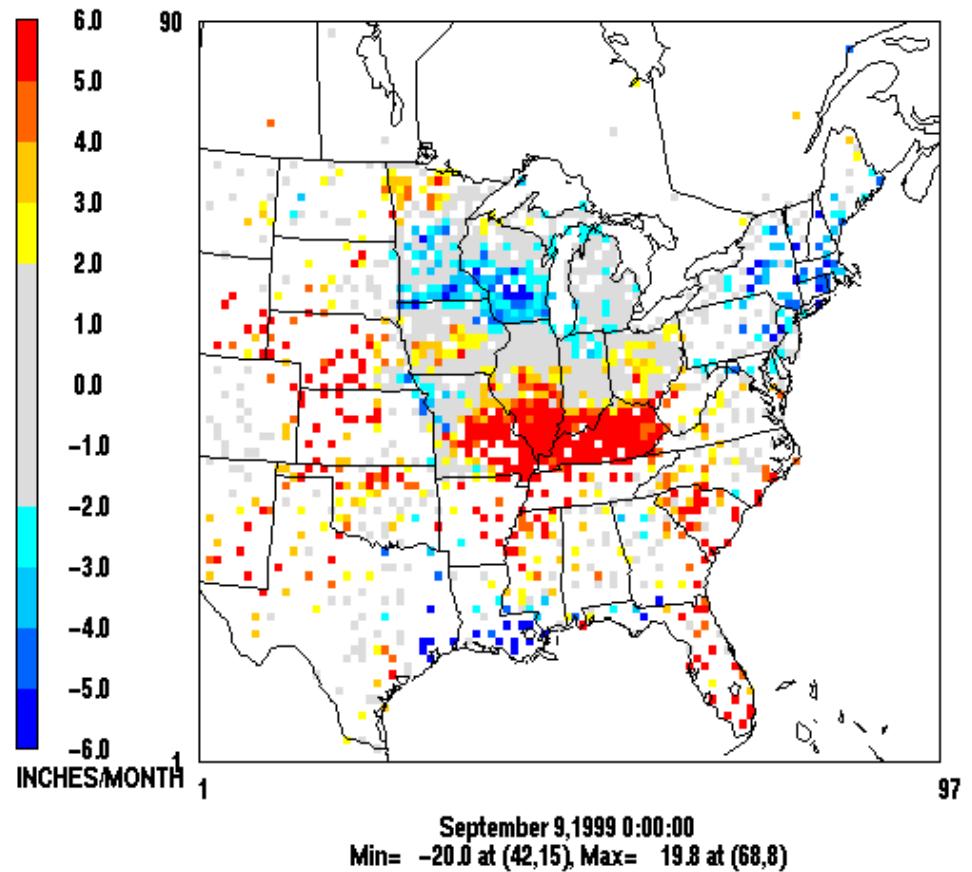
Observation Data



# Rainfall Predictions - Observations

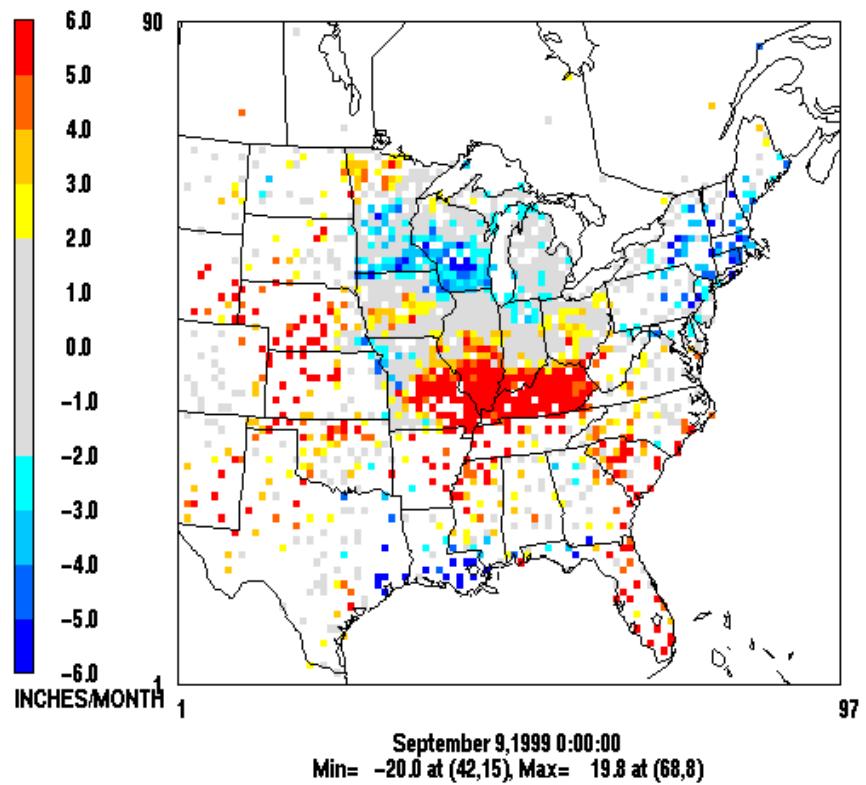
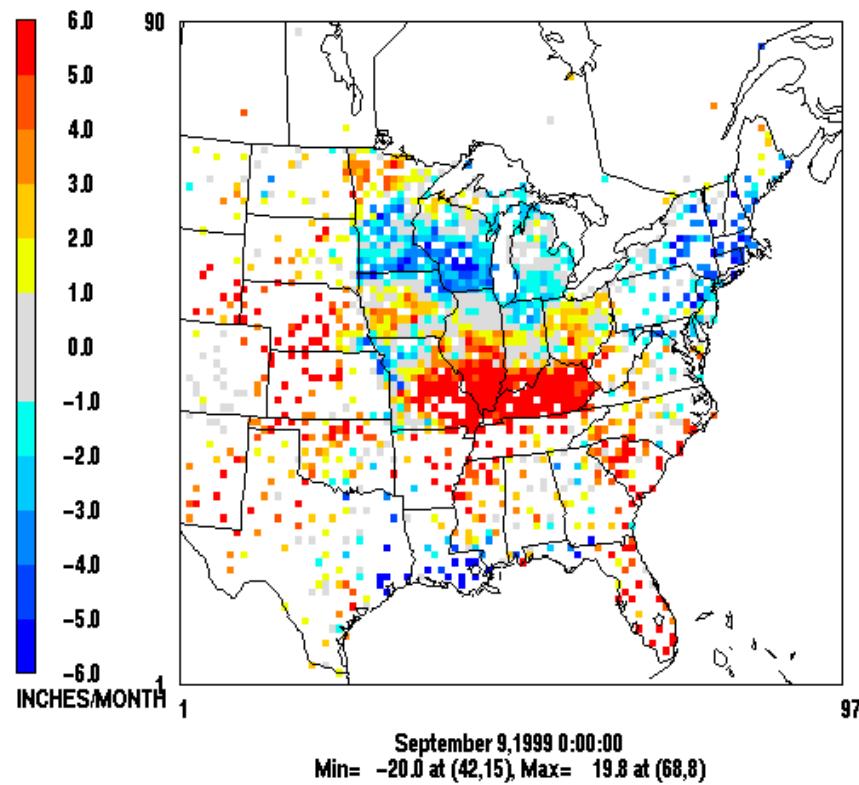
## July 2001

- Over-predictions in the Ohio River Valley, Central Plains, South Carolina
- Under-predictions in the Wisconsin area and New England
- “Good” in Iowa, northern Illinois, Indiana, and Michigan
- What is good and bad rainfall performance?



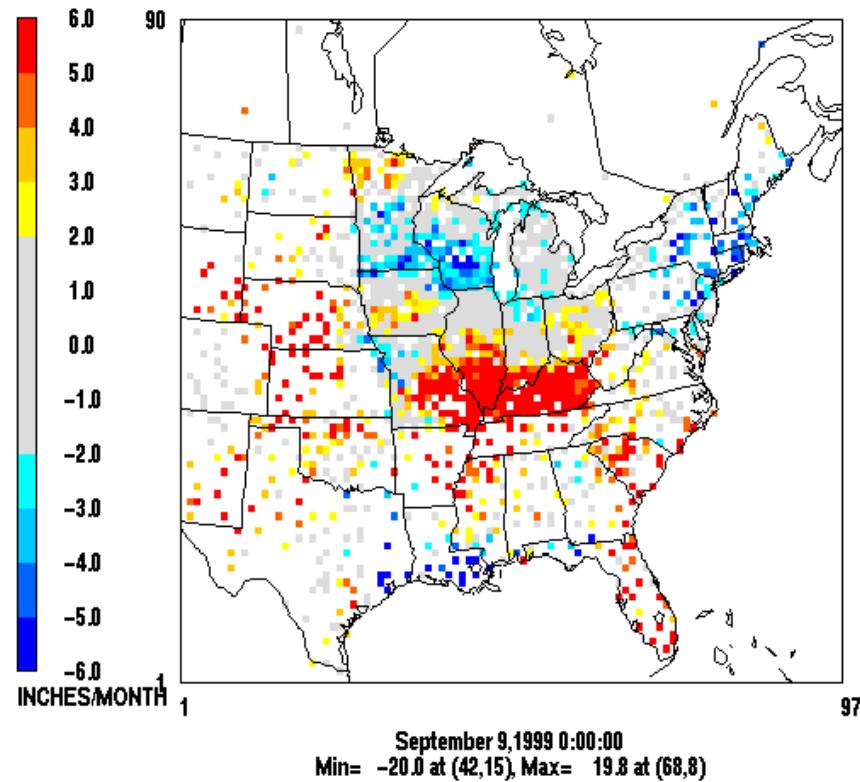
# What is “good” performance?

- $\pm$  1 inch/month
- $\pm$  2 inches/month

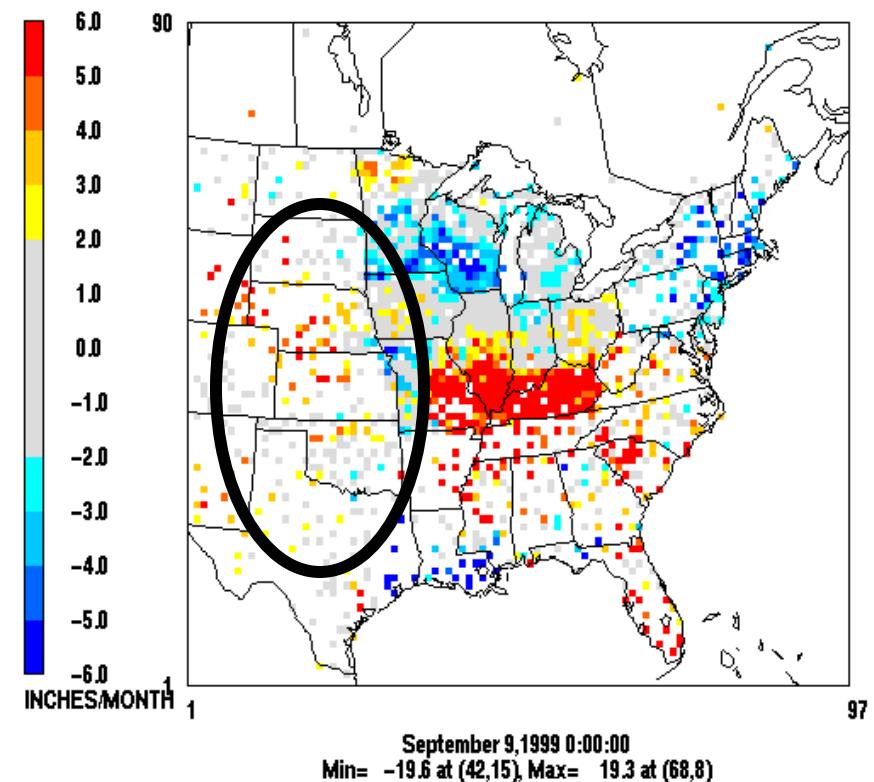


# PX With and Without Reinitialized Soil Data

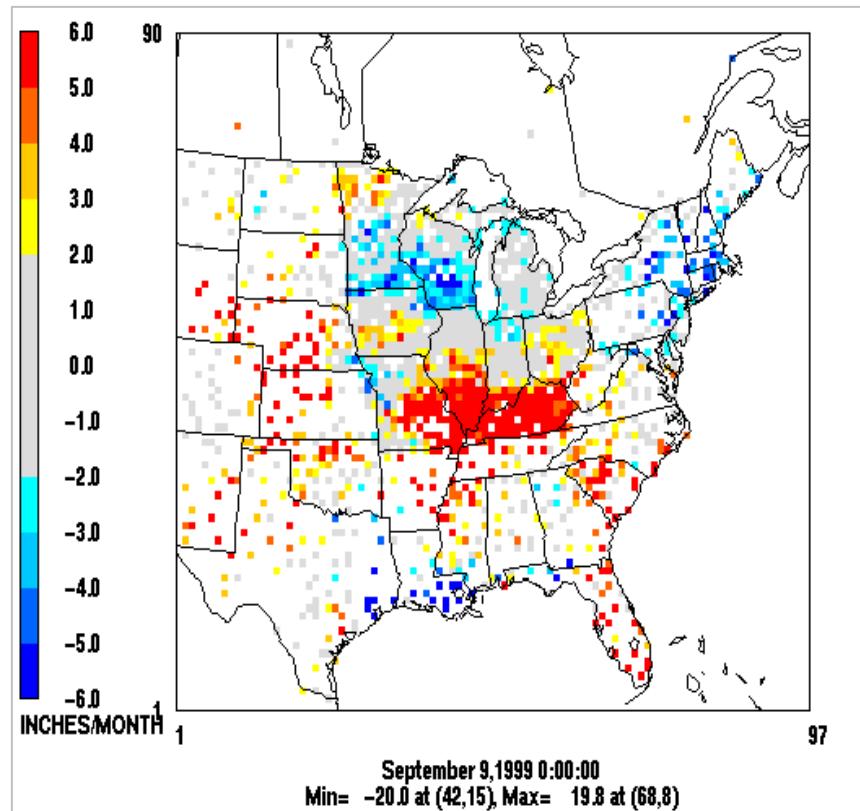
ETA Soil Initialization



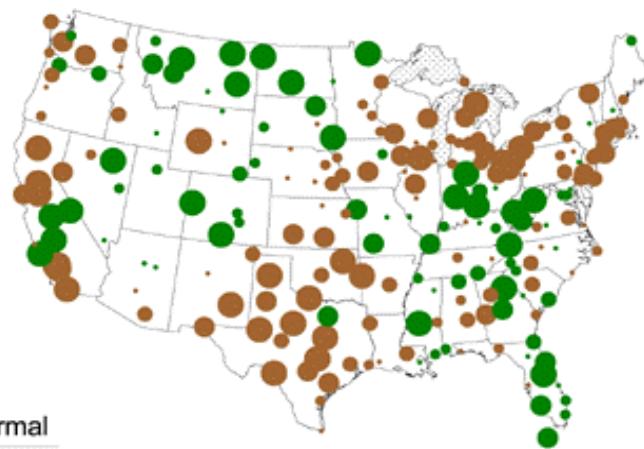
Soil Initialization from previous MM5 run



# Rainfall Bias & Monthly Normal



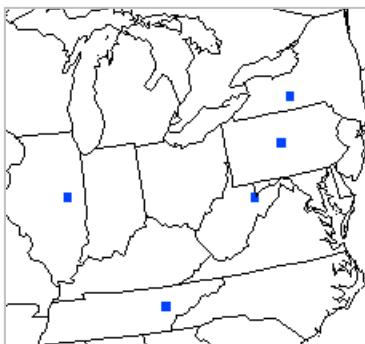
July 2001 Precipitation  
Percent of 1961-90 Normal



# Photochemical Performance

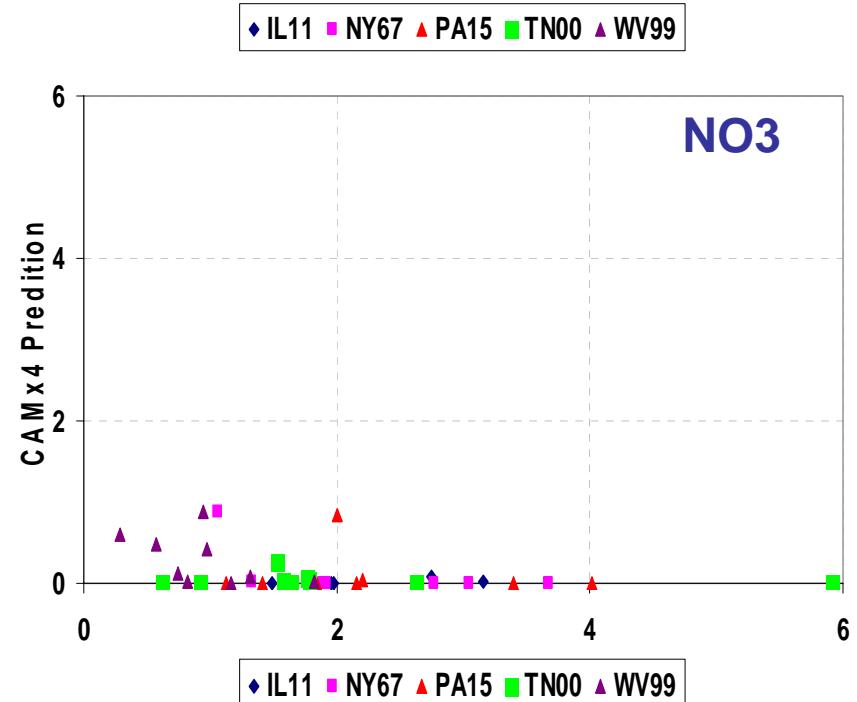
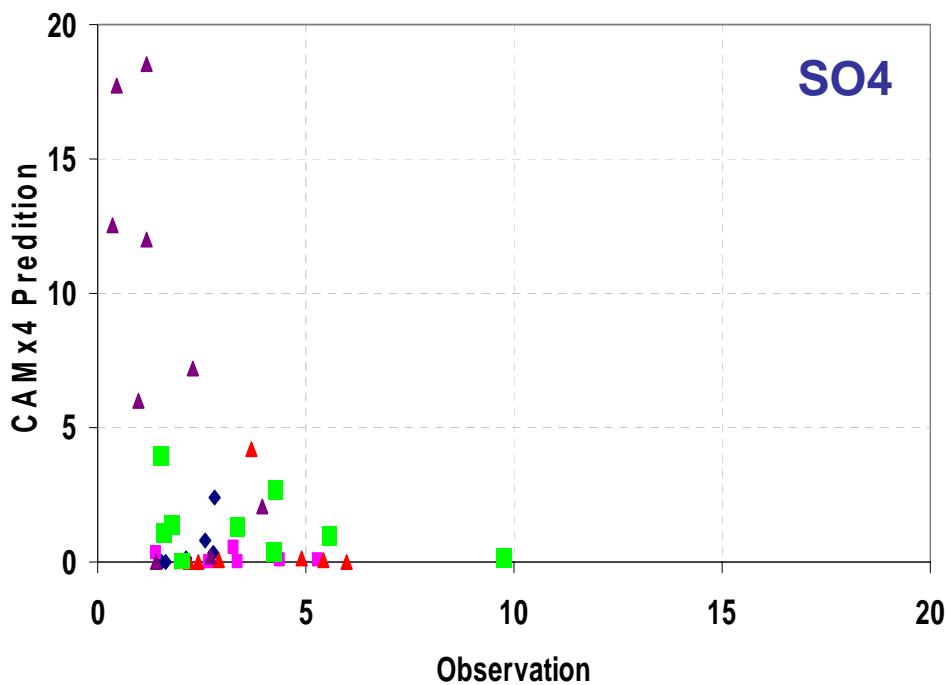
- Rainfall bias may directly translate into wet deposition bias in the photochemical model over the month
- Alternatively, deposition bias may have a stronger link to model chemistry and/or emission uncertainty

# CAMx4 Wet Deposition (g/ml) Analysis for July 2001



NADP monitors

♦ IL11 ♦ NY67 ▲ PA15 ■ TN00 ▲ WV99



## Part II Conclusions

- Difficult to gauge rainfall performance
- Rainfall performance does not seem to directly translate into photochemical model wet deposition performance
- Wet deposition may not be a strong enough pollutant removal mechanism in the photochemical models to see the direct relationship (dry deposition and chemistry may be stronger)